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Special pension schemes for workers in arduous and hazardous jobs: Functions and conditions to ensure equal treatment

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Abstract Most jurisdictions grant differentiated and more beneficial treatment – usually in the form of early retirement, and commonly under special pension schemes – to workers in arduous or hazardous jobs. Several justifications for such treatment have been advanced, including i) compensating the worker for the hardship, ii) protecting the worker from the hazard, and iii) realizing the principle of equality in the distribution of costs and benefits in the social security system. This article analyses these functions from a socioeconomic perspective and explains how early retirement for workers in arduous and hazardous jobs is necessary to ensure equality by treating “unequals unequally”, and in proportion to their inequality. Moreover, this article presents a precise formula to calculate when a worker should be allowed to retire, so that workers in occupational domains with a shorter life expectancy do not systematically enjoy lower expected benefits from the pension system while having contributed the same amount. Implications for the design and desirability of special pension benefits are discussed.

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Introduction

Differentiated and more beneficial treatment, dispensed only to certain people covered by the social security system, requires a justification to comply with the principle of non-discrimination or with the constitutional right of equal treatment. In fact, most countries provide special pension benefits to workers in arduous or hazardous jobs based on the grounds that they compensate workers for the hardship of the job, protect workers from the hazards of the work or, more rarely, are required to realize equality and implement proportional justice. In the European Union (EU), more than two-thirds of the countries have special pension schemes for workers in arduous or hazardous jobs (Natali, Spasova and Vanhercke, 2016; Eckefeldt and Pătărău, 2020), and recent reforms introduced a full-fledged system providing special benefits to such workers in Italy, France and Finland.¹⁴ In Brazil, the People's Republic of China, and the Russian Federation, the norm that allows such workers to retire earlier is understood to perform a crucial social role and has remained virtually intact throughout all recent reforms of these national social security systems.

Still, several crucial questions remain. In what dimensions are those workers different? This depends, as will be explained, on the current amount of effort and energy that workers spend on their work and on the different risks they are exposed to; namely, the present risk of injury and accident as well as the future risks of incapacity, illness, and the reduction in quality and expectancy of life that arise due to the type of work they perform. The suitability of special pension schemes to compensate workers for, or protect them from, each of these harms depends on the structure of the market in which they intervene. This determines to what extent workers are already compensated through wage premiums for some of those harms, whether and to what extent they still need to be compensated for other harms, and whether there are other branches of the social insurance system that already provide such compensation. Moreover, at what cost should their situation be equalized? This answer determines the extent to

1. In Italy, the benefit was introduced by Decreto Legislativo 11 Agosto 1999 and regulated by Decreto Legislativo 21 Aprile 2011. In France, it was introduced by *Loi 2010-1,330 du 9 novembre 2010*, regulated by *Loi 2014-40 du 20 janvier 2014*, and subsequently reformed by the *Ordonnance 2017-1,389 du 22 septembre 2017*. In Finland, the “years-of-service” pension is regulated in the *Työntekijän eläkelaki* [Employees Pensions Act] (395/2006), Section 53.

which special pension schemes should be shaped to foster the prevention of arduous and hazardous working conditions and who should pay for the costs of the scheme. In the end, the most relevant question to be addressed is *what kind* of equality, if any, should be offered, and to *whom* and *when*? It determines to which extent the statutory retirement age should differ depending on the hazards that workers are exposed to. Accordingly, this article specifies *when* a worker who has worked for a certain number of years in an arduous or hazardous job should be allowed to retire, depending on different factors, with the aim to ensure fairness in the pension system by balancing out contributions and expected benefits.

This debate has acquired high relevance as differentiated benefits have been advanced as a fair and adequate measure to counterbalance the trend of increasing the retirement eligibility age for workers, which imposes a disproportionate burden on those whose health suffers due to arduous or hazardous work. These workers are the ones who are most at risk from the current policy shift towards longer working lives. The European Commission, in fact, has recognized how:

“a specific category that often benefits from more favourable schemes and rules covers workers in arduous and hazardous jobs. Even though, during the past decade, the main trend has been towards tightening eligibility conditions and phasing out schemes, some countries have pushed through reforms creating more favourable conditions for this category” (European Commission, 2018, p. 105).

The International Labour Organization (ILO) Invalidity, Old-Age and Survivors' Benefits Convention, 1967 (No. 128), asserts that “[i]f the prescribed age is 65 years or higher, the age shall be lowered, under prescribed conditions, in respect of persons who have been engaged in occupations that are deemed by national legislation, for the purpose of old-age benefit, to be arduous or unhealthy” (article 15). The physical effort and strenuousness involved in certain professions justifies the worker's exit from the arduous or hazardous job since workers need to be in good physical condition to exercise their job and might be unable to perform a physically strenuous activity well when at an older age. There are, however, different policies apt to redress their situation, and these policies have different financing mechanisms, which are more or less just depending on the extent to which they correct or create unequal conditions for workers in arduous or hazardous jobs.

This article analyses the functions and justifications advanced by scholars, courts and legislators for differentiated and more beneficial treatment of workers in arduous or hazardous jobs. While there are different rights that the law might grant to such workers (Eckefeldt and Pătărău, 2020), the most paradigmatic and

usual one is a lower retirement age compared to workers in the general scheme. In the analysis that follows, the focus lies on this right, denoted herein the “special pension benefit” that workers in arduous and hazardous jobs might be entitled to. The legal analysis considers European countries that provide such a benefit to those workers as well as for the three emerging countries mentioned, namely Brazil, the People’s Republic of China (hereafter, China), and the Russian Federation (hereafter, Russia).

Results provide insights into *why* special pension schemes are in place and concern *how* they should be designed to realize legitimate legal goals. In specifying the negative consequences of special pensions, and comparing them with alternative policies, this article reveals when special pensions could and should be substituted for alternative ones, what the main threats are to their implementation and, consequently, to achieving legitimate legal goals. The essential function of special pensions that is not performed by any other branch of the social security system is to create a fair distribution of costs and benefits between workers who suffer a reduction in life expectancy caused by the work they perform and those who do not face this risk. To perform this function without creating an unequal treatment that is not justified, the special benefit provided to these workers must be calculated precisely, and this article specifies how the special benefit should be calculated.

The remainder of the article is organized as follows: next, the main ways by means of which different legal systems recognize arduous and hazardous jobs, and the type of benefit most often provided to those workers, are described. In turn, the consequences of arduous and hazardous jobs that can justify the goals of compensation, protection, and fairness, as well as alternative social policies that also perform those functions are explained. The article then investigates these three potential functions of special pensions and draws the contours of how the special scheme should be designed to perform these, including the sources of finance and interaction with other policies. Before final conclusions are presented, the article specifies the conditions for special pensions to ensure the equal treatment of workers in unequal conditions and presents a formula to calculate the retirement age of workers in arduous and hazardous jobs.

Legal recognition and treatment of arduous and hazardous jobs

Most countries with a well-established social security system provide differentiated and more beneficial treatment to workers in jobs or working conditions that the law recognizes as arduous or hazardous. Out of the 27 EU Member States, only five do not have any differentiated provision for those workers (Denmark, Ireland, Malta, the Netherlands and Sweden) (Natali, Spasova and

Vanhercke, 2016). In Brazil, beneficial treatment allows workers exposed to heavy hazards to retire up to 15 years earlier than the minimal retirement age, in Russia up to 10 years earlier, and in China, France and Italy up to 5 years earlier.² In contrast, many countries including Australia, Japan, Switzerland and the United States of America do not have any special provision for those workers.

Few countries have a legal definition of arduous or hazardous work. The French Labour Code (art. L4121-3-1) considers *pénible* – a concept that includes both elements of arduous and hazardous work (Volkoff, 2015) – those jobs in which the employee is “exposed to one or more factors of professional risk determined by decree and connected to marked physical constraints, an aggressive physical environment or certain health patterns likely to have a lasting, identifiable and irreversible impact on health”. Countries that have such an abstract definition provide lists of environmental conditions that allow workers who can demonstrate that they were exposed to those factors to claim more beneficial treatment. In China, for instance, these conditions include underground work, high altitude, high temperature, strenuous activity, or any other work that is harmful to the health or body.³ Other usual factors include underwater work, handling of certain chemical materials, or proximity to nuclear elements.

Most countries, however, recognize arduous and hazardous work for broad categories of workers through lists of occupations or professions that are deemed arduous or harmful, such as work carried out by miners, metalworkers, aircraft staff and pilots, dancers, seafarers, assembly line workers, drivers of heavy vehicles, and bullfighters. Other countries recognize only a few occupations as arduous or hazardous and define workers in those fields as entitled to some social protection benefit that is tailored to them. For instance, Germany and Norway grant early retirement only to miners and seafarers.

When recognized, workers engaged in arduous or hazardous activities are entitled to special provisions that facilitate early labour market exit. While the special benefit dispensed to such workers consists most often in access to full pension benefits prior to reaching the statutory pensionable age and, but less often, in the possibility of part-time work with full or almost full wages at an older age, it can also be implemented through a more advantageous accrual of pension rights or, at least in theory, through lower contributions paid by those workers while still active.

2. In Brazil, the matter is regulated by *Lei No. 8.213/1991*, art. 57; in China, by the *State Council's Provisional Measures Concerning the Retirement and Resignation of Workers*, art. 1, Number 2; in Italy, by *Decreto Legislativo 21 Aprile 2011*, n. 67, art. 1; in France, by the *Code de la Sécurité sociale*, art. L351-6-1.

3. In China, the *State Council's Provisional Measures Concerning the Retirement and Resignation of Workers*, art. 1, Number 2.

Table 1. *Consequences of arduous and hazardous work*

Arduous	Hazardous		
	Present	Present	Future
Exceptional physical effort and energy	Risk of accident and injury	Risk of incapacity to perform (i) the specific work or (ii) any type of work	Risk of illness causing (i) reduced life quality or (ii) reduced life expectancy

Source: Author's elaboration.

In fact, after years of debate, and several legislative changes to the initial project, France adopted a full-fledged system of specific provisions in 2014 (with substantial changes in 2018) that provide a menu of choices for those workers. It considers *pénible* any work involving night shift, work shift, repetitive work, work in a hyperbaric chamber, or when exposed to extreme temperatures and noise. These workers accumulate points over the years that they can later use i) for early retirement, ii) to change from full-time to part-time work without wage reduction, or iii) for the financing of educational programmes to reconvert to another profession.⁴

The consequences of arduous and hazardous jobs

Arduous work means exertive or strenuous work that requires a high level of physical or mental effort and energy. The classification of a certain activity as arduous requires a comparison between such an activity and those that require a level and intensity of effort and energy considered normal, average, or median (Bruno, 2015). There are objective criteria to measure the exceptional effort and energy spent while in a job, such as calories spent per hour of work (while seated desk-work consumes 92 kilocalories per hour, working on a car assembly line consumes 176, gardening 323, coal mining 425, and loading trucks 435) (Lieberman, 2013, p. 219), but the classification of a job as arduous is always a subject of debate (for instance, how many more calories does a worker need to consume for a job to be considered arduous in comparison to another job).

Hazardous work imposes risks to the worker's health. These include, as depicted in Table 1, i) the present risk of accident or injury while working, ii) the future risk that the worker will not be capable to perform either the specific job she or he performs or any type of job in the future, and iii) the future risk of illness causing a reduction in life quality or in life expectancy. Certain jobs might

4. See text of the *Code de la Sécurité sociale*, art. L4163-7.

involve one or more of those risks. Carrying very heavy loads, for instance, involves the present risk of injury to the back, the risk that this will develop into a permanent back injury preventing the worker from performing virtually any type of job in the future, and the risk of reduced quality of life after retirement due to injury-related movement difficulties. In contrast, working in contact with asbestos might not impose, by itself, any risk of accident or injury in the present, nor the incapacity to perform the job in the future, but instead, potentially, a heavy toll on a person's life expectancy due to the development of serious illness in old age (Alleman and Mossman, 1997).

The future risks involved in hazardous jobs include, for example, the long-lasting harm caused by mine dust on miners (leading to pneumoconiosis), hyperoxia and decompression stress on commercial divers (leading to a loss of lung function), contact with mercury, lead, arsenic, silica and other chemical agents by industrial or construction workers (leading to different serious diseases), and of low-dose exposure to ionizing radiation by workers in nuclear facilities (leading to cancer) (Schubauer-Berigan et al., 2015).

Potential functions of special pension schemes

To compensate the worker for hardship or hazard

The first potential function of special pension schemes is to compensate the worker for the arduousness of, or for hazards related to, the work. It involves the intervention of the State in the labour market by providing a benefit to affected workers as compensation for such negative consequences of the work. A competitive labour market, however, already has mechanisms providing some form of compensation to workers in those sectors through wage premiums. Instead of operating in a vacuum, the legal intervention allowing workers in those jobs to retire earlier interacts with wages set in the labour market, and the final consequence for the worker – i.e. the provision of a real compensation or not – might be different from the one intended by the legislator.

In the absence of special pension benefits, workers in a competitive labour market will consider how arduous or hazardous the job is and will accept it in place of some other job that does not involve such conditions only if they are offered some offsetting advantage such as a higher wage. Firms must offer compensating wage differentials to incentivize workers into accepting such jobs (Rosen, 1986; Hwang, Reed and Hubbard, 1992). Compensating differentials are necessary to equalize the monetary advantages and nonmonetary disadvantages (arduousness or hazard) among different jobs, with evidence of positive wage premiums for shift work (Kostiuk, 1990; Lanfranchi, Ohlsson and Skalli, 2002),

work in contact with pollution (Cole, Elliott and Lindley, 2009), seasonal work (Del Bono and Weber, 2008), unsafe and dangerous work (Gunderson and Hyatt, 2001; Lalive, 2003), and work involving the risk of a fatal accident (Black and Kniesner, 2003; Viscusi and Aldy, 2003; Kniesner et al., 2012). Workers in those sectors earn higher wages than workers in normal sectors and employment levels in arduous and hazardous sectors are lower than in normal sectors.

In the presence of special pension benefits that are not subsidized, the costs of financing the benefit are borne only by the involved parties; namely, either employers, employees, or both in any specific proportion. The benefit – early retirement – has a value for workers, given by the present value of the stream of pension payments that they will receive during the years of early retirement, and that they would not receive if they were working in other sectors. The effect of early retirement is that to attract workers, employers do not need to offer the same wage premiums that they would need to offer in its absence. The legal intervention is, in this case, innocuous, except for a shift in the timing in which workers receive the compensation for the arduousness or hazard. In the absence of early retirement, they receive it while working, earlier in life, through higher wages. In the presence of early retirement, the wage premium diminishes, and workers receive compensation when they retire. There is no welfare loss as employment levels in those sectors remain at the same level as they would have been in the absence of the mandated benefit, and wage differences reflect the amount that workers value the benefit (Summers, 1989).

In the presence of subsidized special pension benefits, while workers receive the benefit in full, its costs are financed through contributions collected from all insured persons, independent of whether they are entitled to the special benefit, or from all firms, independent of whether they employ workers entitled to it. Employers do not need to offer wage premiums since workers will take those jobs for a lower wage knowing that they are also receiving future compensation for the arduousness or hazard in the form of the right to retire earlier. Employers do not pay for this benefit that their workers receive, and the State compensates those workers by bearing the costs of their early retirement. Therefore, when the benefit is subsidized, it compensates workers, but only at a high price: first, a share of the value of the benefit is captured by firms through their possibility to lower wages and still attract workers; second, arduous and hazardous jobs are maintained instead of reduced; third, the costs of the subsidy are paid by other parties, who must suffer a reduction in the provision of some other public service or bear the costs through higher taxes.

If workers are not aware of the hazard, then they will accept to work for the same wage they would earn in normal sectors. This is problematic for at least three reasons: first, workers are not compensated for the hazard through wage premiums – they are, in fact, if employers are aware of the hazard, being

exploited; second, the hazardous sector employs too many people by taking advantage of the possibility to attract workers without the need to pay wage premiums; third, risk matching does not occur, as workers who are risk averse the most or the least will equally enter that sector, with the risk averse workers being very inefficiently allocated in the job. In this case, special pension benefits such as early retirement compensate workers for the risk they incur without their knowing. However, if the benefit is subsidized, then only a share of its value will be captured by workers, with firms capturing the other share. Employers profit at the workers' and the State's expense and have therefore incentives to employ too many people in industries that would otherwise have vanished or diminished in size given the risk they pose to workers.

Special pensions are, however, most often not necessary to provide compensation for workers. When workers are aware of the arduousness or hazard, they are already compensated by wage premiums, and they are efficiently matched to firms offering wage premiums for the arduousness and hazards that maximize their utility. When workers are, in contrast, unaware of the risk, for instance the risk that work with asbestos or other chemicals impose on their future health, then there are other policies that can simply inform workers directly about the hazard or risks, if the State itself is aware of these, or impose the obligation on employers to inform workers, if firms are aware of these. Many jurisdictions impose the duty to disclose information on firms, as for instance in France, where employers must identify, evaluate, and inform employees about such risks, prevent those that can be prevented, and specify the measures undertaken to mitigate the remaining ones in a collective agreement that must be bargained with a representative body of workers.⁵

Most importantly, there are other branches of the social insurance system that already perform the role of compensating workers for most of the hazards they are exposed to in their jobs. First, the future incapacity to work or to perform the same activity is the object, respectively, of disability pension or occupational disability insurance. While the former insures a worker's income against disabling medical events, the latter insures workers who become disabled and unable to perform the majority of the occupational duties they used to perform. Second, the present risk of injury in hazardous work is the object of workers' compensation. It provides wage replacement and medical benefits to employees injured in the course of employment. Third, the future risk of illness in old age resulting from hazardous work is the object of health insurance and long-term care insurance. If the worker develops an illness because of the type of work she or he undertook, then health insurance compensates the medical expenditures

5. See the *Code de la Sécurité sociale*, art. L. 4121-1.

necessary to heal the ailment, and long-term care insurance compensates for the incapacity to perform activities of daily living.

The sole consequence of hazardous work that is not addressed by any branch of the social insurance system is the reduction of life expectancy. There are some studies linking worker's occupation to mortality (Johnson, Sorlie and Backlund, 1999; Katikireddi et al., 2017; Lee et al., 2016) or life expectancy (Moore and Hayward, 1990; de Wind et al., 2020; Deeg, Tavernier and de Breij, 2021). The estimates provided by these range from a maximum difference between favourable and unfavourable working conditions of around 2.5 years (de Wind et al., 2020) to 4.5 years at age 55 (Moore and Hayward, 1990), and around 3.3 years at age 65 (Deeg, Tavernier and de Breij, 2021).

To protect the worker from hazard

A second potential function of special pensions is to protect the worker from the hazard of the work. The protection could be achieved in two ways. First, it can provide incentives for employers to invest in prevention and in measures apt to avert the hazard. Second, it can provide incentives for employees to exit those jobs, either by them changing occupation or by retiring early.

When workers are aware of the hazard, then employers already have incentives to invest in prevention, since by doing so they reduce the hazard and thereby lower the compensating wage differential they must pay to hire workers. They will, in the absence of special benefits and, in fact, of any type of legal obligation, invest in prevention until the marginal cost of the investment is equal to its marginal benefit for the firm; namely, the reduction in the wage premium it must pay to attract workers to the risky job. Special pension benefits are not apt to provide incentives for firms to increase investment beyond that point.

When workers are unaware of the hazard, the aptitude of special pensions to reduce risks depends on whether the benefit is subsidized or not. If it is subsidized, then firms profit from the subsidy just as workers do. Since workers are not aware of the risk, firms make no investments to reduce the risk because doing so would not lead to any reduction in wages, as workers are unaware of the risk, and investing to reduce or avert risks only creates costs for the firm, with no monetary gain. Special pensions can provide incentives for firms to invest in preventive measures when workers are not informed, and the benefit is not subsidized. Firms then bear at least a share of the costs of the benefit for their workers, which they can reduce by investing. They internalize the negative externality that hazardous jobs create for workers, and which is because of informational problems not considered in the wages set in the market.

Yet, even in this case, special pension schemes will not create incentives for employers to invest in preventive measures if the benefit is provided to whole categories. A firm that invests in prevention would still have to bear the costs of financing the benefit and has therefore no incentive to do so. A mining company whose workers must work underground cannot avoid the costs of financing early retirement of its employees by allowing them more pauses above ground, providing better equipment, and so forth, if they would still, after all these investments, count as underground workers by law, and remain entitled to early retirement that is financed by the same mining company.

Several types of arduous jobs and hazards are not prevented because of the manner in which the law regulates special pensions. In Italy, for instance, all those working in tunnels, caves, and mines can retire early, just as can all deep-sea divers.⁶ Firms have no incentive to provide better equipment, longer pauses above water for better decompression, or other amenities, because as long as their workers must work underground or underwater, the latter will still be entitled to the benefit, and firms will still have to pay the costs of the benefit independent of the working conditions they provide.

In contrast, if the benefit is provided in an individual manner, and only to workers who are in fact exposed to the hazard in a specific firm, then firms have incentives to invest in prevention. A firm that, for instance, invests by changing its production methods at a cost, to avoid its employees coming into contact with mercury, would then be exempt from having to finance the costs of early retirement of those workers because those jobs would no longer fall under the category of “hazardous”. Workers, in turn, would not require higher wages to perform that job in that specific firm.

The recent reforms in France were explicitly aimed at preventing arduous and hazardous jobs. The system entitles workers who are exposed to certain risk factors in a specific firm – and not to whole professions or categories – to special benefits. It imposes on the employer the duty to issue a declaration of the risks that each individual employee is exposed to, and to create a “personal prevention account” for each of them. Since some of the costs of the benefit are borne by those firms exposing workers to hazards, it is apt to achieve its purpose.

Special pensions schemes protect workers in hazardous jobs through permitting early exit from the hazardous job, thus avoiding the risk that the worker might lose further years of life expectancy were she or he to remain in the job until the statutory retirement age. By allowing the worker to retire earlier, she or he is spared from working for a greater number of years in the harmful job, and hence avoids greater harm caused to health. Instead of retiring at, for example, the minimum retirement age of 65, after 35 years of hazardous work, the worker

6. *Decreto Legislativo 21 Aprile 2011*, art. 1, 1, a.

who is allowed to retire at age 60, after 30 years of hazardous work, avoids working five more years in that job, and thereby is less exposed to the risk of suffering harm.

While this is apt to partially protect the worker from harm, it offers only a limited benefit for workers, unless they are allowed to retire much earlier, which is extremely rare. If having worked in a hazardous job (for example, underground mining) for five years diminishes a person's life expectancy by one year, a worker who starts working at age 30 and retires at age 60 loses, in expected terms, 6 years of her or his life expectancy. This loss can be compared to that of a worker who does not enjoy preferential treatment and who retires at age 65, with an expected loss of 7 years of life. Early retirement or a change to part-time work in old age cannot ever completely prevent the harm: this would require a prohibition of those jobs.

To implement equal treatment

A third potential function of special pension schemes is to realize the “principle of equal treatment”: to treat “equals equally and unequals unequally” in proportion to the inequality. Treating all workers indistinguishably, and allowing them all to retire only at, say, age 65 is unjust with regard to those workers who contribute the same amount to the financing of the system but who have a life expectancy of no more than 65 years. Equality in the distribution of goods (benefits from the social security system) to persons who are unequal in one relevant aspect of old-age insurance (namely, life expectancy) requires proportional, and not numerical, equality (Aristotle, *n.d.*, V. 3. 1131a10-b15, cited in Barnes, 1984).

If a worker in a hazardous job has a lower life expectancy than another worker because of work-related risks (hence, being unequal), the average reduction in the life expectancy (the proportion of the inequality) is known, and if they both contribute equally to the pension scheme by paying the same contribution rate, then by allowing the worker in a hazardous job to retire proportionally earlier, this inequality is corrected, and both workers contribute to and profit from the pension system equally.

In the absence of differentiated treatment, workers who have a lower life expectancy because of the hazards involved in their work systematically enjoy lower benefits from the pension system than other workers: they receive pension payments for less time but contribute to the financing of the system to the same extent. In the absence of special treatment, and when the contribution rate paid by them does not depend on the hazard of the job (as is the case in all jurisdictions known to the author), there is redistribution of income from workers in hazardous jobs to workers in “normal” jobs.

There is no legitimate reason why such a pattern of redistribution should be accepted, and correcting it seeks to implement the legal principle of, and constitutional right to, equality.

Consider, for instance, workers entering the labour market at age 20, as depicted in Figure 1. In normal jobs, workers retire at age 65, after 45 years of work, and live on average until age 80, enjoying 15 years of pensions. Therefore, for every three years of work, the worker earns one year of pension. In a hazardous job, we expect workers to have a lower life expectancy. Consider, for instance, an activity that reduces the life expectancy by one year for every five years of work. After working 45 years, the worker loses nine years of life expectancy, and enjoys pensions for only six years. Accordingly, for every 7.5 years of work, the worker earns one year of pension.

Special pension schemes implement unequal treatment for workers with unequal life expectancy. If allowed to retire at age 59, instead of at age 65, they create two immediate effects. First, as explained before, special pensions offer some protection for the worker from the hazard as it leads her or him to exit the job earlier; in this example, saving 1.2 years of life expectancy (as the worker only works for 39 years in the hazardous job, instead of 45 years). Second, it avoids redistribution from the worker in hazardous sectors to other workers: she or he works for 39 years and then enjoys 13 years of pensions. For every three years of work, she or he earns one year of pension, just as workers in normal jobs do.

Figure 1. *Distribution of costs and benefits in the social security system*



Source: Author's elaboration.

How to ensure equal treatment in retirement conditions for workers in arduous and hazardous jobs

To be apt to realize equal treatment, special pension schemes must, first, provide a general differentiated requirement for the concession of the benefit that is proportional to the life-expectancy reduction. This ensures that any worker who is exposed to the hazard is entitled to the benefit. It is therefore incompatible with systems that provide this special benefit only to a few categories of workers, such as those providing early retirement only to miners or seafarers, as in Germany or Norway. While apt to correct the inequality between these and other workers, it does nothing to all for those others not covered by those restrictive and exceptional rules.

Second, the differentiated requirement must be based on an *ex ante* accurate measure of life expectancy, given the harm imposed by the performed activity (Zaidi and Whitehouse, 2009). This leads to an “unequal treatment of unequals” that is proportional and just. Otherwise, it would be arbitrary, reflecting only the respective bargaining and political power of different groups of workers. If it were arbitrary, then it would create inequality rather than avoid it, by conferring a benefit to individuals who are equals and by imposing the duty to pay for it upon others who are also equals.

Third, the scheme must consider the possibility of workers changing jobs during their lifetime, and hence consider the real hazard suffered by each individual worker. The consequences of the hazard might be nonlinear and therefore complicated to calculate, such as in cases where the consequences start to materialize only after many years of work under the same conditions, and then grow at an exponential rate. While job changes should be considered, the years spent in non-hazardous jobs should not count for the special benefit. The Italian system, for instance, used to provide early retirement to workers in listed types of jobs if they had held the job for at least seven out of the last ten years before applying for retirement; starting from 2018, they must now have spent at least half of their career in those jobs. Neither the old rule nor the new one is compatible with providing truly proportional treatment, because a worker who has spent 40 years working underground is likely to suffer a higher reduction in life expectancy than a fellow worker who has worked underground for seven or 20 years.

To address this challenge, and considering all the above requirements, a way to achieve more equal treatment can be calculated precisely, according to the formula below. The retirement age in hazardous jobs R_h shall depend on the general statutory retirement age R_n , on the number of years spent on the hazardous job y_h , on the hazard rate h imposed upon the individual worker, on the general life expectancy at the statutory retirement age in the population of the country L , and on the numbers of years that workers in normal jobs y_n must work to retire:

$$R_h = R_n - y_h h + (R_n - R_h)(L/y_n)$$

The term $y_h h$ captures the loss of life expectancy caused by y_h years of hazardous work, and the last term on the right-hand side of the equation captures the protective function of special pensions through early exit from the hazardous job ($R_n - R_h$), weighted by the accrual rate, in years, in other non-hazardous jobs L/y_n .

The key argument is that it is insufficient simply to allow a worker who, for example, has worked for 20 years in a harmful job, which carries the risk of a loss 0.2 years of life expectancy per laboured year, simply to retire four years earlier. This would be neither proportional nor truly fair. If one were not to consider the last term of the equation, and the protective function of early retirement for those workers, then assuming a general life expectancy of 80 years in the population, age 65 as the general retirement age, that workers in normal jobs need to work three years for one year of pension, and that this worker starts working at age 20, then she or he could retire at age 61.⁷

She or he would work for 41 years, from age 20 until age 61, and live until age 76, given the expected loss of four years of life expectancy. After 41 years of work, she or he would enjoy an expected 15 years of pension income, wherein 2.73 years of work would have been required for each year of pension, which is less than workers in normal sectors.

Instead, following the formula above, this person should be allowed to retire at age 62, according to the formula:

$$\begin{aligned} R_h &= R_n - y_h h + (R_n - R_h)(L/y_n) \text{ or } R_h \\ &= 65 - 20 \cdot 0.2 + (65 - R_h)(15/45) = 62 \end{aligned}$$

In this case, she or he would work for 42 years, lose 4 years of life expectancy for the 20 years laboured in the hazardous job, and enjoy an expected 14 years of pension income, from age 62 until age 76. She or he would have to work three years for each year of pension, just as workers in other sectors.

When determined in this precise manner, the special benefit is fair and proportional, fulfilling all the conditions discussed above: it is i) general, ii) based on an ex ante accurate measure of life expectancy given the hazard imposed by the performed activity, and iii) considers only those years worked in a hazardous job and, therefore, the associated harm.

One of the difficulties in calculating *when* a worker should be allowed to retire in this manner is related to the assessment of the hazard rate h , which depends on the type of work undertaken by the worker for a period of y_h years. Different activities

7. This would correspond to simply using the formula $R_h = R_n - y_h h$. In the example above, it would correspond to $R_h = 65 - 20 \cdot 0.2 = 61$.

impose a different toll on the worker's life expectancy, and this rate h should be based on the average harm imposed on workers performing the same activity. Some workers in a certain hazardous job might, in fact, live longer than workers in normal jobs, and these workers would benefit disproportionately from early retirement. Yet, workers in the hazardous job would not be systematically better or worse off, on average, than workers in normal jobs if allowed to retire at R_h . In fact, the injustice that workers performing the same job for the same number of years might die at different ages, some benefiting more from the pension system than others, is inherent to old-age social insurance, and special pension schemes do not correct for this type of injustice. Rather, they aim to correct for injustice across types of jobs and occupations. In the absence of special pension schemes, miners would, for example, systematically receive lower benefits from the pension system because of their lower life expectancy caused by the job.

A further difficulty is related to the age at which the worker starts performing the activity. If it is assumed that the harm imposed on life expectancy is greater for workers who start performing the job at an older age than for workers who start at a younger age, then a refined measurement of h , potentially dependent on the age at which the worker started performing that activity, should be considered if available.

Conclusion

Special pension benefits can perform different socioeconomic functions and the purpose they promote depends on how they are financed. If the intended purpose is to compensate workers to a higher extent than wage premiums set in a competitive labour market, then the special pension benefit must be subsidized. However, an outcome of this is that subsidized benefits allow employers to capture a share of the subsidies, which acts to help maintain jobs and sectors that would otherwise decline. Furthermore, the provision of the right to retire earlier, as a means to protect workers by preventing the hazard, is rarely apt to incentivize investments in prevention by employers. Of course, early retirement does lead workers to exit the hazardous jobs earlier, and when they do so, they are no longer exposed to the hazard, and thereby are protected from further harm. The effect is slight, however. Unless the worker is allowed to retire much earlier, the reduction in life expectancy that early retirement avoids is small. Similarly, alternatives such as a change to part-time work or developing new work competencies (so called "re-capacitating") or occupational reorientation programmes for older workers in arduous or hazardous jobs are equally suitable to prevent further harm, but effective to a limited extent only.

The proposal presented in this article explains how to achieve fair treatment using special pension schemes. As argued, required is an approach that is

proportional in the realization of equal treatment for those who bear the consequences of hazardous work on life expectancy but who should also contribute to its financing equally, and who otherwise would not be in an equal position to benefit from the pension system as do other workers. Special pension schemes, thus, should be designed precisely in this manner to redresses this inequality, otherwise the risk is to create special pension schemes that exacerbate unequal treatment by generating privileges solely for well-organized groups of workers.

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